

BEHAVIOR OF PANTANEIRA AND GIROLANDO HEIFERS REARED ON PASTURES IN THE FOUR SEASONS OF THE YEAR¹

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ABSTRACT - The objective of this study was to evaluate feeding and physiological dynamics of Pantaneira and Girolando heifers reared on pasture and their preference for three types of natural shadows. Fourteen animals, seven of each breed, with mean weight of 328 kg (Pantaneira) and 430 kg (Girolando) were used. The pasture consisted of *Panicum maximum*; the animals' behavior in open areas and under treetops (*Anadenanthera colubrina*; *Terminalia argentea*, and *Mangifera indica*) was evaluated. Two 24-hour observations were performed per station, totaling 192 hours of data collection. The experimental design was completely randomized, using 4×2×3 (station × breed × canopy) and 4×2 (station and breed) factorial arrangements, with 7 replications. *M. indica* was the preferred tree species by both breeds in all seasons; Girolando animals remained longer under the canopy of these trees during winter and spring. Feeding dynamics of the two breeds was similar, with a seasonal effect on the standing rumination (SR) variables and social interaction, with Girolando spending more SR time in the spring (230.0 min) and less interaction in the summer (53.57min). Girolando animals searched for water more often during summer. No statistical differences or interactions between factors were found for urination and defecation of the animals, except for defecation in the summer period, which was higher than in the other seasons.

Keywords: Naturalized cattle. Animal comfort. Ethology. Shadow.

COMPORTAMENTO DE NOVILHAS PANTANEIRA E GIROLANDO CRIADAS EM PASTAGENS NAS QUATRO ESTAÇÕES DO ANO

RESUMO - O objetivo deste estudo foi avaliar a dinâmica alimentar e fisiológica de novilhas Pantaneira e Girolando criadas em pastagem e a preferência por três tipos de sombras naturais. Foram utilizados 14 animais, sete de cada raça, com peso médio de 328 kg (Pantaneira) e 430 kg (Girolando). O pasto consistia em *Panicum maximum*. Foi avaliado o comportamento dos animais em áreas abertas e sob as copas das árvores (*Anadenanthera colubrina*; *Terminalia argentea* e *Mangifera indica*). Duas observações de 24 horas foram realizadas por estação, totalizando 192 horas de coleta de dados. O delineamento experimental foi inteiramente casualizado, utilizando arranjos fatorial 4 × 2 × 3 (estação × raça × copa) e 4 × 2 (estação e raça), com 7 repetições. *M. indica* foi a espécie arbórea preferida pelas duas raças em todas as estações. Os animais Girolando permaneceram mais tempo sob o dossel das árvores durante o inverno e a primavera. A dinâmica alimentar das duas raças foi semelhante, com efeito sazonal nas variáveis de ruminação em pé (RP) e interação social, com Girolando gastando mais tempo de RP na primavera (230,0 min) e menor interação no verão (53,57 min). Animais Girolando procuraram por água com mais frequência durante o verão. Não foram encontradas diferenças estatísticas ou interações entre fatores para micção e defecação dos animais, exceto para a defecação no período de verão, que foi maior que nas demais estações.

Palavras-chave: Gado naturalizado. Conforto animal. Etologia. Sombra.

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INTRODUCTION

Thermal exchange by convection is an important thermoregulation mechanism for ruminants, which makes thermal homeostasis possible. However, this mechanism depends on energy exchange, which occurs between the surface temperature of the animal's fur and the air temperature in the environment (TRIPON et al., 2014; DE OLIVEIRA et al., 2018; RASHAMOL et al., 2018). Thus, when the external temperature is high, this mechanism becomes ineffective and the animals are subjected to a thermal stress, with profound physiological and behavioral changes and significant reduction in food consumption and zootechnical performance. Shadowed areas are required for animals, even in regions with average temperatures below 24 °C, to mitigate the negative effects of ultraviolet rays; these shadows can be natural or artificial (RODRIGUES; SOUZA; PEREIRA FILHO, 2010; KARVETTE et al., 2016).

Ethological evaluations are important when evaluating changes in behavioral patterns of animals focused on climatic changes, especially food intake, since it is directly affected by the air temperature and is directly correlated to the animals' performance. Grazing time is affected by food availability and nutritional quality, physiological need of the animal, stress level, and presence of parasites and diseases (FACURI et al., 2014).

Pantaneiro cattle were introduced to the Pantanal biome, in the State of Mato Grosso do Sul, Brazil, hundreds of years ago by Spanish and Portuguese during the South America colonization. According to Oliveira et al. (2015), this breed underwent a natural selection process, which gave them high rusticity, mainly regarding their capacity to withstand high temperatures, periods of intermittent drought and flooding, ectoparasites and endoparasites, and seasonal variations in the quality of forage resources.

Thus, behavioral studies on Pantaneiro cattle are important, because of scarcity of technical information about this breed and its current risk of extinction; approximately 500 pure individuals are kept in government conservation centers and some private farms. The loss of a breed, such as the Pantaneira, is an irreversible damage to the world's science and livestock, since these animals carry singular and desirable genes for animal production (DANI; OLIVEIRA, 2013).

Girolando cattle originated from the crossing between Gir and Holstein animals; it is characterized as a synthetic breed of Brazilian genetic heritage. It contributed significantly to the strength of national dairy cattle; the physiological and morphological characteristics of these animals are suited to the tropics, presenting excellent body shape, good fur pigmentation, high capacity of self-regulation of body heat, and high grazing efficiency; which gives

them great resistance, adequate adaptability to the environment, and a high performance.

Therefore, the objective of this study was to evaluate feeding and physiological dynamics of Pantaneira and Girolando heifers reared on pasture in the four seasons of the year and their preference for three types of natural shadows in the High Pantanal region, in Mato Grosso do Sul, Brazil.

MATERIAL AND METHODS

The experiment was carried out at the Milk Excellence Center of Mato Grosso do Sul, of the Universidade Estadual de Mato Grosso do Sul (UEMS), in Aquidauana, MS, Brazil (20°27'S, 55°40'W, and altitude of 167 meters). According to the classification of Köppen, the region presents a tropical climate of Savanna with dry winter (aw).

Fourteen heifers—seven Pantaneira and seven Girolando ($\frac{3}{4}$ Holstein x $\frac{1}{4}$ Gir)—with approximately 18 months and weights of 328±14 kg and 430±28 kg, respectively, were used. All animals were identified with an earring and kept together in a 6-hectare *Panicum maximum* pasture area divided into paddocks and managed in a rotational system. The heifers were treated prophylactically against endo/ectoparasites and had water and mineral salt ad libitum.

Although pasture was rotated, the animals were observed always in the same paddock; this paddock had natural shading by three trees species—*Anadenanthera colubrina* (CP1), *Terminalia argentea* (CP2), and *Mangifera indica* (CP3).

Mangifera indica is an arboreal species that can solve the thermal environmental problems that affects animals in the tropics; its canopy provides significant welfare to the animals due to the its pleasant microclimate by its dense foliage and wide shade (LOUREIRO; BARBOSA, 2010). *Terminalia argentea* is a tree species that colonizes low fertility soil, produces wood, but generates small shade (OTSUBO et al., 2015). *Anadenanthera colubrina* is a typical species of the Cerrado biome; it has a scattered canopy, small leaves, and arched branches that facilitate the passage of light and increase the incidence of solar radiation under the canopy, raising the temperature in this microclimate. According to Nepomuceno et al. (2007), this is a deciduous species, presenting falling of leaves during the dry season as a physiological adaptation mechanism.

Feeding and physiological dynamics were evaluated according to a methodology adapted from Garry, Sherritt and Hale (1970) and Oliveira et al. (2015), with observations made in the four seasons of the year. Two 24-hour observations were made in each season of the year, totaling eight observations, beginning at 6:00 a.m., totaling 192 hours of observation. The data were organized in spreadsheets developed for behavioral tests. Collection was made

by trained evaluators, four at a time, in a relay system, positioned strategically to not disturb the animals and interfere with their behavior. The animals' body temperature (BT) was checked with one-hour intervals using a digital infrared thermometer. Nighttime observations were performed using night vision binoculars.

Feeding dynamics was evaluated using the parameters: standing rumination (SR), which represents the dynamics of the food after regurgitation when the animal is standing; lying down rumination (LDR), which is the same as SR, but when the animal is laid down; sleeping on foot (SF), when the animal is standing and with eyes closed and is not ruminating; sleeping lying down (SD), when the animal is laid down with eyes closed and is not ruminating; leisure state (LS), when the animal does not present any type of action; eating (EAT), which comprises the movements of food intake; and social interaction (INT), when the animal is not ruminating, eating, idling, urinating, defecating, or ingesting water, but in any activity of movement or social interaction.

The parameters considered for the physiological dynamics were the number of times the animals ingest water, defecate, and urinate within the evaluation period.

The preference of the animals for the different trees for shade was determined by summing the time they spend during the day in the shadows with the time they stay under the treetops at night.

In each period of observation, forage samples were collected using a simulated grazing technique. The grass was collected for 40 minutes, starting at 7:00 a.m. The evaluators followed the animals, keeping a distance lower than 2 meters, to observe the grazing habit of the heifers and their preference for the structural components of the forages. After homogenizing the material, a sample of 500 g was stored in a freezer (-20 °C) and, then, used to determine partial dry matter, final dry matter, crude protein, neutral detergent fiber, and acid detergent fiber (PROHMANN et al., 2012). The availability of forage biomass was determined by the square frame technique, in which a square frame is randomly launched at the paddocks and the grass sample encompassed is collected with cutting close to the ground and immediately weighed for quantification.

Data on air temperature and relative humidity were collected with 60-minute intervals, using portable digital devices positioned at full sun and under tree shades during the day, and at the open field and under the treetops at night (Table 1).

Table 1. Maximum and minimum air temperature and humidity obtained at the open field and under canopies of the different tree species, during 24-hour periods.

Seasons	Index	Temperature (°C)				Humidity (%)			
		Open field ¹	Canopy A ²	Canopy B ³	Canopy C ⁴	Open field ¹	Canopy A ²	Canopy B ³	Canopy C ⁴
Winter	Maximum	32.8	32.8	32.5	33.0	92	92	92	92
	Minimum	16.8	18.6	18.0	18.5	51	53	54	56
Spring	Maximum	39.2	38.4	38.0	37.0	81	69	78	80
	Minimum	24.9	20.1	25.1	24.9	42	41	44	45
Summer	Maximum	44.1	38.9	37.2	35.0	91	88	89	90
	Minimum	21.3	23.8	23.2	22.4	40	44	44	43
Autumn	Maximum	37.8	35.2	36.8	34.2	92	92	92	90
	Minimum	20.1	22.5	22.2	21.8	41	41	40	46

¹Any area in the paddocks, except under the treetops; ²*Anadenanthera colubrina*; ³*Terminalia argentea*; ⁴*Mangifera indica*.

The canopy type of the trees was compared using a completely randomized design in a 4×2×3 factorial arrangement (season × breed × tree species) with 7 replications; the animals were the experimental units. The animal behavior was compared using a completely randomized design in a 4×2 factorial arrangement (station × breed) with 7 replications, and the animals were the experimental units. The data were evaluated using the R 3.3.0 statistical program (R Core Team, 2016), with a significance level of 5%. The means were compared through the Tukey's test at 5% probability level.

RESULTS AND DISCUSSION

The nutritional quality of the grass used (*Panicum maximum*) varied throughout the year. The highest biomass production was found in the wet period, with maximum yield in the summer (6,403.34 kg ha⁻¹) and a higher leaf to stem ratio in the spring. The lowest values of protein were found in the autumn and winter; forage yield and acid detergent fiber (ADF) concentration decreased during this dry period, increasing the lignification of the grass (Table 2).

According to Van Soest (1994), protein levels lower than 7% and high ADF are undesirable because they limit ruminal microbial fermentation

and reduce animal consumption. Gregorini et al. (2011) reported that feed availability and nutritional quality directly affect the feeding dynamics of

grazing cattle, and an increase in the bit rate and time spent on grazing is frequently observed in the animals in periods of low forage availability.

Table 2. Chemical composition of the dry matter of *Panicum maximum* cv. Mombaça and its leaf, stem, and senescent material fractions in the four seasons.

Variables	Spring	Summer	Autumn	Winter
Dry Matter - %	24.2	24.8	24.7	26.6
Crude Protein - %	7.4	7.8	4.3	4.2
Neutral Detergent Fiber - %	69.5	69.5	64.0	69.9
Acid Detergent Fiber - %	47.6	46.9	48.1	53.3
Ash - %	9.1	9.3	10.5	10.6
Production DM ¹ - kg/hectare	4,279.8	6,403.3	4,006.9	3,731.3
Leaf - %	67.0	68.0	53.0	50
Stem - %	21.0	25.0	30.0	32
Senescent Material - %	12.0	7.0	17.0	18
Sheet/stem ratio	3.2	2.7	1.8	1.6

The factors (station x breed x shading) presented significant interactions. The season of the year, type of shading, and breed of the heifers affected the animals shade choice. Girolando animals remaining in shades of *Mangifera indica* in the spring during 64.7% of the 24 hours daily (932.8 min) (Table 3). Karvette et al. (2016) reported that the tree canopy can reduce by up to 28.3% the thermal radiation load. According to Biavatti, Berber and Berber (2014), shade in grazing paddocks decreases the animals' thermal stress by providing a

better thermal comfort, and increase the animal production.

According to Silva et al. (2012), Girolando animals need shaded environments; they found a decrease of 2.5 kg in milk yield when Girolando cows were not provided with shades for two hours prior to milking. Carvalho et al. (2018) compared Girolando animals on grazing systems and, as in the present work, found that $\frac{3}{4}$ Holstein \times $\frac{1}{4}$ Gyr animals are less heat tolerant than $\frac{1}{2}$ Holstein \times $\frac{1}{2}$ Gyr animals.

Table 3. Unfolding of the interaction (Station \times Breed \times Shading) for preference of trees (*Anadenanthera colubrina*, *Terminalia argentea*, and *Mangifera indica*) for shading.

Season	Breed	Shading (min day ⁻¹)		
		<i>A. colubrina</i>	<i>T. argentea</i>	<i>M. indica</i>
Winter	Pantaneira	33.6 bB	19.3 aB	366.4 eA
	Girolando	12.8 bB	62.1 aB	461.4 dA
Spring	Pantaneira	35.7 bB	5.0 aB	824.3 bA
	Girolando	37.1 bB	19.3 aB	932.8 aA
Summer	Pantaneira	42.8 abB	20.0 aB	605.0 cA
	Girolando	132.1 aB	40.7 aC	690.0 cA
Autumn	Pantaneira	17.8 bB	15.7 aB	342.8 eA
	Girolando	47.1 abB	37.1 aB	330.0 eA

¹Means followed by the same lowercase letters in the columns or uppercase letters in the rows do not differ by the Tukey's test at 5% probability level.

The interaction between the factors (station \times breed) was not significant for time of permanence at the open field and under treetops (Table 4).

Several studies on the cattle performance on pastures have been developed in the Cerrado-Pantanal ecotone region, but many consider that this region has only two well-defined seasons, dry (June to October) and rainy (November to May) (PAULA et al., 2010; VILELA et al., 2011; DE MORAES,

2012). These studies disagree with the findings of the present work about the animals' behavior and search for shadow.

The permanence time of Pantaneira and Girolando heifers at the open field and under the treetops presented significant difference in the four seasons of the year. During autumn and winter, the animals remained at the open field for an average of 1,044.64 and 962.14 min, totaling 72.5% and 66.8%

of the time, respectively. The greatest demand for shade was in the summer ($P < 0.05$) with mean time spent of 927.14 min, representing 64.4% of the time (Table 4).

Baliscei et al. (2013) reported that silvopastoral systems make the environment more harmonic because they reduce the climatic differences between seasons. Leme et al. (2005) evaluated the time spent in the sun or shade by Holstein-Zebu cows in a silvopastoral system and found that the animals remain 14.9% longer in the sun during winter, and 37.2% longer in the shade during summer.

The breed affected the time the Pantaneiros animals stayed at the open field, which was 118.57 min longer (59.6) ($P < 0.05$) than the Girolando

(51.3%) (Table 4). This confirms the lower demand for shade of Pantaneira cattle for thermoregulation and denotes its ability to remain longer at the open field in face of climatic variations throughout the year. The greater tolerance of Pantaneira heifers to sun exposure is explained by their natural selection throughout the years in which the breed was introduced in the Brazilian Pantanal region, which gave them greater rusticity and adaptation to the heat (DANI; OLIVEIRA, 2013).

Bos indicus breeds regulate body temperature better than *Bos taurus* (LESS, et al., 2018). Pantaneiros cattle are *Bos taurus* animals (BARBOSA, et al., 2014), but they were superior to the Girolando, which is $\frac{1}{4}$ of *Bos indicus*.

Table 4. Permanence time of Pantaneira and Girolando heifers at the open field and under the treetops in the four seasons of the year.

Season	Open field ¹ (min/day)	Total Canopy ² (min/day)
Winter	962.2 a	477.8 c
Spring	512.8 c	927.2 a
Summer	674.6 b	765.4 b
Autumn	1,044.6 a	395.4 c
Breed		
Pantaneira	857.9 a	582.1 b
Girolando	739.3 b	700.7 a
Interaction		P value
Season×Breed		>0.05
Coefficient of Variation (%)		14.12

Means followed by the same lowercase letters in the columns do not differ by the Tukey's test at 5% probability level; ¹Any area in the paddocks, except under the treetops; ²Sum of the permanence time under the treetops of *Anadenanthera colubrina*, *Terminalia argentea*, and *Mangifera indica*.

The interactions between the factors were not significant for body temperature variables (Table 5). The lowest body temperatures were found in the winter and there was no difference between breeds. According to Shiota et al. (2013), the seasons affect physiological parameters of the animals; they found significant differences in body temperature in Nelore heifers managed in grazing systems in winter and summer, with averages of 35.9 and 37.3 °C, respectively.

Barbosa et al. (2014) reported that the fur temperature is affected by air temperature, but found no significant differences between Red Nelore, Nelore, and Pantaneira breeds. The Pantaneiro cattle have a less thick fur and higher percentage of sweat glands tissues and, consequently, a higher transpiration rate than Holstein cattle (BIANCHINI et al., 2006), thus, they can maintain thermal

homeostasis with greater efficiency. However, the lack of significant differences between breeds in the present study can be attributed to the degree of Zebu blood of the Gir breed in the Girolando animals. The neck, upper front leg, and croup temperatures of Pantaneiro animals were 30.7, 32.6, and 31.9 °C respectively. Similar results were found by Barbosa et al. (2014)—33.6 °C for neck, 33.7 °C for rib, and 34.3 °C for croup.

Among the variables of feeding dynamics, the interactions between the factors were significant for the standing rumination (SR) and social interaction (Tables 6 and 7).

The seasons of the year had no effect on lying down rumination, sleeping on foot, lying down sleeping, and eating. The longest time for leisure was found in spring, with 341.78 min day⁻¹, representing 23% of the daily time (Table 6).

Table 5. Surface body temperature of Pantaneira and Girolando heifers in different seasons of the year.

Variables	Neck (°C)	Upper front leg (°C)	Croup (°C)	Average* (°C)
Season				
Winter	28.21 b	29.21 b	28.36 b	28.59 b
Spring	31.51 a	31.90 a	31.37 a	31.60 a
Summer	32.09 a	32.56 a	31.90 a	32.17 a
Autumn	31.23 a	31.70 a	30.79 a	31.24 a
Breed				
Pantaneira	30.72 a	31.40 a	30.81 a	30.98 a
Girolando	30.79 a	31.26 a	30.40 a	30.81 a
Interaction				
Season*Breed	P value >0.05	P value >0.05	P value >0.05	P value >0.05
Coefficient of Variation (%)	7.23	7.3	8.61	7.58

*Average of neck, upper front leg, and croup temperatures. Means followed by the same lowercase letters in the column do not differ by the Tukey' test at 5% probability level.

Tripon et al. (2014) evaluated similar variables in the winter and summer times and found effect of the season on dairy calf behavior, including lying down, resting, standing up, feeding,

ruminating, drinking, and self-grooming; the total eating period was shorter in winter (442.1 min) when compared to the summer (543.5 min).

Table 6. Feeding dynamics (minutes per day) of Pantaneira and Girolando heifers in the different seasons of the year.

Variables	SR	LDR	SF	SD	LS	EAT	INT
Season							
Winter	142.1 ab	285.4 a	7.5 a	74.3 a	250.4 ab	595.7 a	84.6 a
Spring	195.0 a	321.1 a	2.1 a	102.8 a	341.8 a	431.1 a	46.1 b
Summer	140.0 b	303.6 a	2.8 a	100.7 a	235.4 ab	580.7 a	76.8 ab
Autumn	141.1 b	375.7 a	8.6 a	128.6 a	187.8 b	537.1 a	61.1 ab
Breed							
Pantaneira	142.3 a	293.0 a	7.0 a	104.1 a	247.0 a	577.7 a	68.9 a
Girolando	166.8 a	349.8 a	3.6 a	99.1 a	260.7 a	494.6 a	65.4 a
Interaction							
Season*Breed	P value <0.05	P value >0.05	P value <0.05				
CV (%)	46.08	54.66	96.18	85.74	67.38	55.02	91.7

Standing rumination (SR); lying down rumination (LDR); sleeping on foot (SF); sleeping lying down (SD); leisure (LS); eating (EAT), and social interaction (INT). Means followed by the same lowercase letters in the column do not differ by the Tukey' test at 5% probability level.

The time of standing rumination of Girolando animals was longer ($P < 0.05$) in spring (Table 7). Dairy animals prefer to ruminate lying down, with the ventral part next to the ground, however they spend less time lying down when the temperature increases, and prefer standing rumination (DAMASCENO; BACCARI JÚNIOR; TARGA, 1999; SCHÜTZ et al., 2009). In this experiment, standing rumination favored thermal comfort under extreme heat as a strategy to increase surface body area and facilitate contact with winds to dissipate heat. The breeds also differed in SR in the spring season; Girolando animals spent more time ruminating standing up.

Pantaneira heifers spent more time interacting in the summer, whereas Girolando spent more time interacting in winter (Table 7). This behavior is attributed to environmental temperatures and adaptive characteristics of the breeds, with a lower heat stress and greater social interaction of Pantaneira during the summer, and a greater interaction of Girolando animals during winter when the temperatures were milder. Ferro et al. (2016) found that Nelore animals show greater social interaction and playful behaviors when managed in shady environments and with absence of thermal stress.

Table 7. Unfolding of the interactions for the standing rumination and social interaction variables.

Variables	Season	Breed	
		Pantaneira	Girolando
Standing rumination (min day ⁻¹)	Winter	107.8 aA	176.4 bA
	Spring	160.0 aB	230.0 aA
	Summer	157.8 aA	122.1 bA
	Autumn	143.6 aA	138.6 bA
Social interaction (min day ⁻¹)	Winter	64.3 bB	105.0 aA
	Spring	58.6 bA	53.6 bA
	Summer	100.0 aA	53.6 bB
	Autumn	72.8 bA	49.3 bA

Means followed by the same lowercase letters in the columns or uppercase letters in the rows do not differ by the Tukey's test at 5% probability level.

Among the physiological dynamics, the interaction between the factors was significant only for water intake (Table 8). The number of times Pantaneira cattle searched for water was similar in all seasons. Girolando animals had greater demand for

water in the summer ($P < 0.05$), however, they sought for water less than Pantaneiras ($P < 0.05$), except in the summer season. Thus, despite water consumption was not evaluated, it is believed that Girolando animals had a greater water intake.

Table 8. Unfolding of the interaction of the water intake variable.

Water intake (Number of times per day)	Season	Pantaneira	Girolando
		Winter	1.5 aA
	Spring	1.5 aA	1.1 bB
	Summer	1.3 aB	2.1 aA
	Autumn	1.2 aA	1.1 bA

Means followed by the same lowercase letters in the column do not differ by the Tukey' test at 5% probability level.

Water is an important nutrient, especially during periods of thermal stress, due to its physical properties of thermal conductivity and latent heat of vaporization, which transfer heat from the animals' bodies to the environment. Increases in air temperature above the thermoneutral zone cause variations in amount of water consumed and body water loss (RASHAMOL, et al., 2018; SAIZI, MPAYIPHELI; IDOWU 2019).

Ferro et al. (2016) found a significant increase in water consumption of cattle under an intensive system with little shades, from 15.50 to 8.17 times for 0% and 80% light interception, respectively. Oliveira et al. (2015) evaluated Pantaneira heifers in a feedlot and found average water intake of 7.6 times a day, which is higher than that found in the present study on pastures (1.3 times). Water demand may be different when considering the playful behavior of the animals and, therefore, not related to water intake requirements, since animals kept in stalls and under permanent shade are not subjected to sudden changes in temperature.

The mean defecation times were 2.4, 2.8, 3.8, and 2.8 in winter, spring, summer, and autumn, respectively; the highest fecal production ($P < 0.05$) was found in the summer, due to the better forage quality—high leaf to stem ratio and higher PB and NDF concentrations—in this season (Table 1). Contrastingly, Tripon et al. (2014) evaluated dairy

calves in winter and summer and found no effect of the season on defecations, with 7.8 times a day in winter and 8.2 in summer.

The Pantaneira and Girolando breeds presented no significant differences ($P > 0.05$) in mean number of daily defecations, with 2.9 and 3.8 times, respectively.

Averages daily urination was 2.2, 2.7, 3.1, and 2.6 times in winter, spring, summer, and autumn, respectively; the animals urinated more frequently ($P < 0.05$) in the summer due to the higher water intake, mainly Girolando heifers. The Pantaneira and Girolando breeds presented no significant differences ($P > 0.05$) in mean number of daily urinations, with 2.6 and 2.7 times, respectively.

CONCLUSIONS

The preferred tree species for shading by the Girolando and Pantaneira heifers was *Mangifera indica* in all seasons, mainly for Girolando heifers. The feeding dynamics was similar between the breeds, however, Pantaneira heifers presented a better adaptation to the climatic conditions of the Pantanal biome and, consequently, a greater resistance to heat in the summer season, with less water demand and more time spent on social interactions.

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